Dew Point, Liquid Volume and Dielectric Constant Measurements in Vapor Mixtures of Methane + Propane and Methane + Propane + Hexane using a Microwave Apparatus

E.F. May
School for Oil & Gas Engineering and School of Physics, University of Western Australia, Crawley, W.A., Australia

T.J. Edwards[S]
School for Oil & Gas Engineering, University of Western Australia, Crawley, W.A., Australia

A.G. Mann[C] and C. Edwards
School of Physics, University of Western Australia, Crawley, W.A., Australia

An apparatus based on a microwave resonant cavity has been used to measure dew points and liquid volume fractions in binary and ternary mixtures of methane, propane and hexane. The microwave cavity is optimised for the measurement of small liquid volume fractions in lean natural gases. Argon and carbon dioxide were used to calibrate the resonator for dielectric constant and liquid volume measurements in mixtures. Estimated uncertainties are 50 ppm for dielectric constants, about (0.05 K, 0.05 MPa) for dew points and about 0.1 % for liquid volume fractions. For a $x C_3H_8$-$(1-x)CH_4$ mixture with $x = 0.2494 \pm 0.0008$, densities inferred from (P, T, α) measurements agree within 0.6 % of EOS densities estimated accurate to 0.1 %. Isothermal measurements across the two-phase region of this binary mixture were made within 3 K of the cricondentherm. The lower dew-point pressure predicted by the Peng-Robinson EOS is more than 0.3 MPa above the measured value along this isotherm. The measured maximum liquid volume fraction is ten times smaller than the Peng-Robinson EOS prediction.